THE NATURE CONSERVANCY NEWS

November/December 1979

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DESERTS

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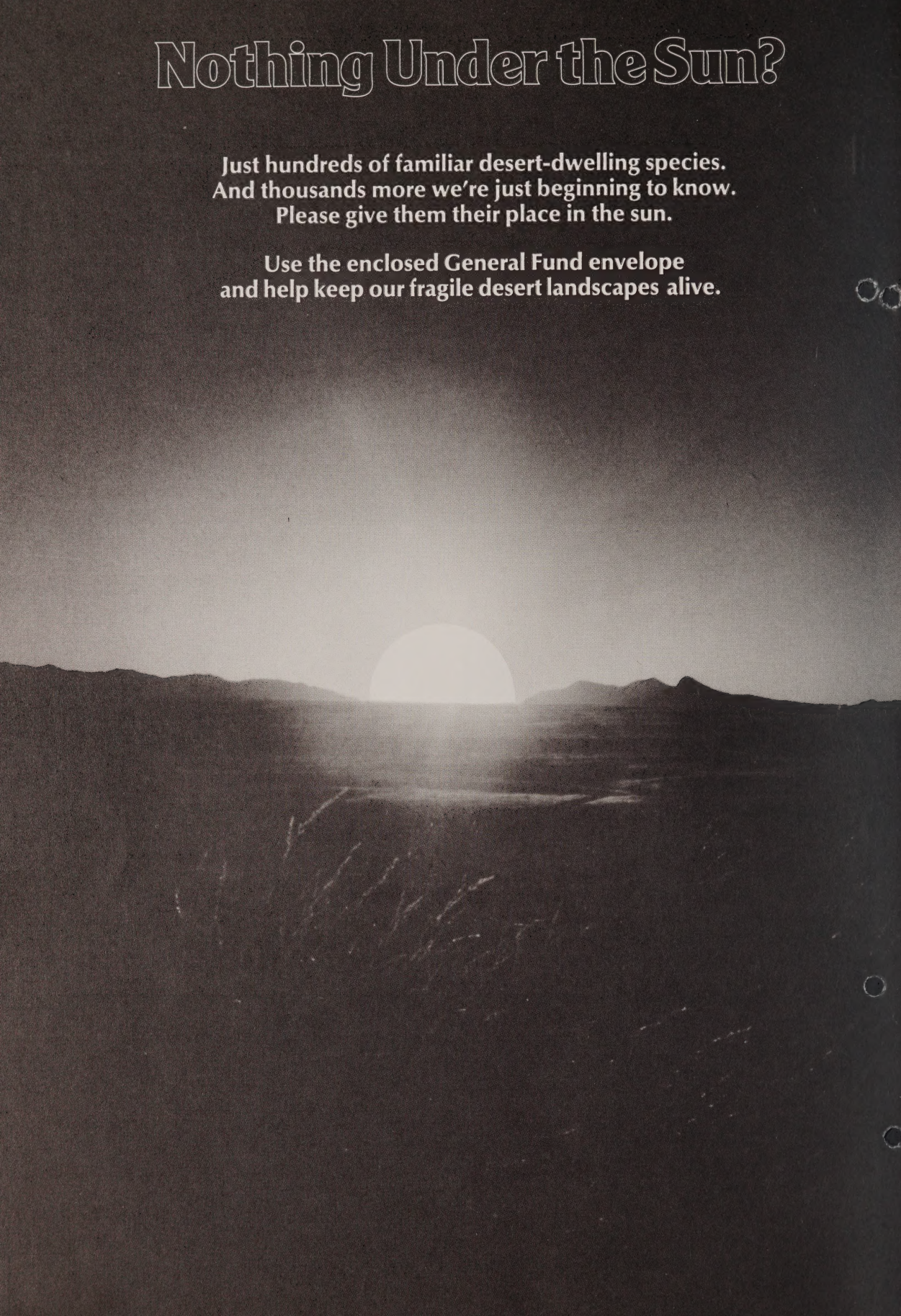

THE NATURE CONSERVANCY NEWS

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COVER: Desert silhouette: organpipe cactus against a resplendent Arizona sky. Photo by Jim Anderson.

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The Nature Conservancy

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To date the Conservancy and its members have been responsible for the preservation of 1,585,347 acres of forests, marshes, prairies, mountains, and islands: home to rare and endangered species of wildlife and plants. 2,231 projects have been completed since the acquisition of the first preserve in 1954. Approximately 60% of all preserves are retained by the Conservancy and managed by volunteer land stewards.

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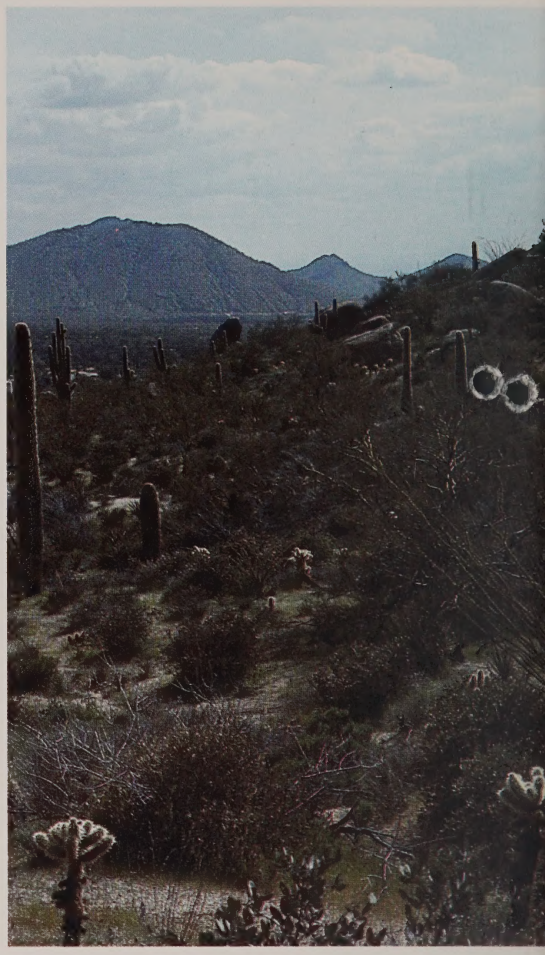
Saguaro cactus

Desert bighorn sheep



America's

by Gerald Lieberman

The hot, dry desert lands of the American southwest are a harsh environment. The resident plants and animals have evolved numerous behavioral and physiological adaptations that allow them to survive. Some deserts have measurable rains only once in several years; some rely solely on the morning dew for their water. No desert, by definition, gets more than 6 inches of rain per year (in comparison to New York City's 42 inches), and many couple their arid climate with intense summer heat.

Dry spots like these are found throughout the world, their locations and extent determined by climatic patterns that are controlled by global air circulation systems. Warm moist air at the equator rises, slowly cools at high altitude, and produces heavy rains in tropical regions. Drained, these air systems lose altitude and slowly return to earth. Because of the earth's rotation, the dry air masses tend to fall on the western sides of continents near 30° north and south latitude. Patterns of ocean circulation result in cold currents at these latitudes, which prevent the desert-bound air masses from reaching the ocean surface and picking up moisture. Under these conditions a desert is created.

In addition to global patterns of climate, the dry conditions of some deserts are intensified by the existence of "rain shadows." Rain shadows result from mountain ranges blocking the movement of storms from the prevailing direction of the wind. When storms moving inland meet a mountain range, they are forced to rise in order to continue on their way. As the air mass rises, it loses its moisture, so it can bring no rain to the far side. The deserts of eastern Washington State, which lie less than 100 miles from the Olympic Peninsula, are a prime example of the rain shadow effect. They are separated from the

Sonoran Desert

Prickly pear cactus

"Undeserted" Deserts

Peninsula's rain forests and almost tropical rainfalls by the Cascade Mountains.

Evolution has enabled plants and animals of the desert to endure not only drastic limitations of water, but intense summer heat as well. Plants have evolved to tolerate severe drought with a variety of adaptations. Most small herbs, for instance, have seeds that can remain dormant in the soil for years until a series of rains trips their germinating mechanisms. Some seeds are shaped like miniature corkscrews. The wind, which blows the seeds off the parent plant, twists them so that the "corkscrews" dig themselves into the sand.

Other plants collect and store water. Cacti have lost their leaves during their long evolution, apparently as an adaptation that allows them to conserve water. The photosynthetic functions of their leaves have been replaced by photosynthesis on their stems and trunks. Some plants, like the ocotillo, have combined stems which photosynthesize with leaves that appear only in years having relatively heavy rains.

Desert animals also have evolved many mechanisms to cope with relentless drought. The kidneys of some small desert rodents have evolved the ability to almost totally recycle water. In fact some of these animals never actually drink water. A few species of kangaroo rat of the American southwest derive fluids purely from the seeds they eat.

Most desert mammals do their foraging in early evening and pre-dawn hours to avoid the desert's intense heat. The largest mammals, which cannot hide from the sun in burrows, have "thermal windows"—thinly haired portions of their undersides —that allow them to lose body heat. Some animals forage during the morning and late afternoon, like

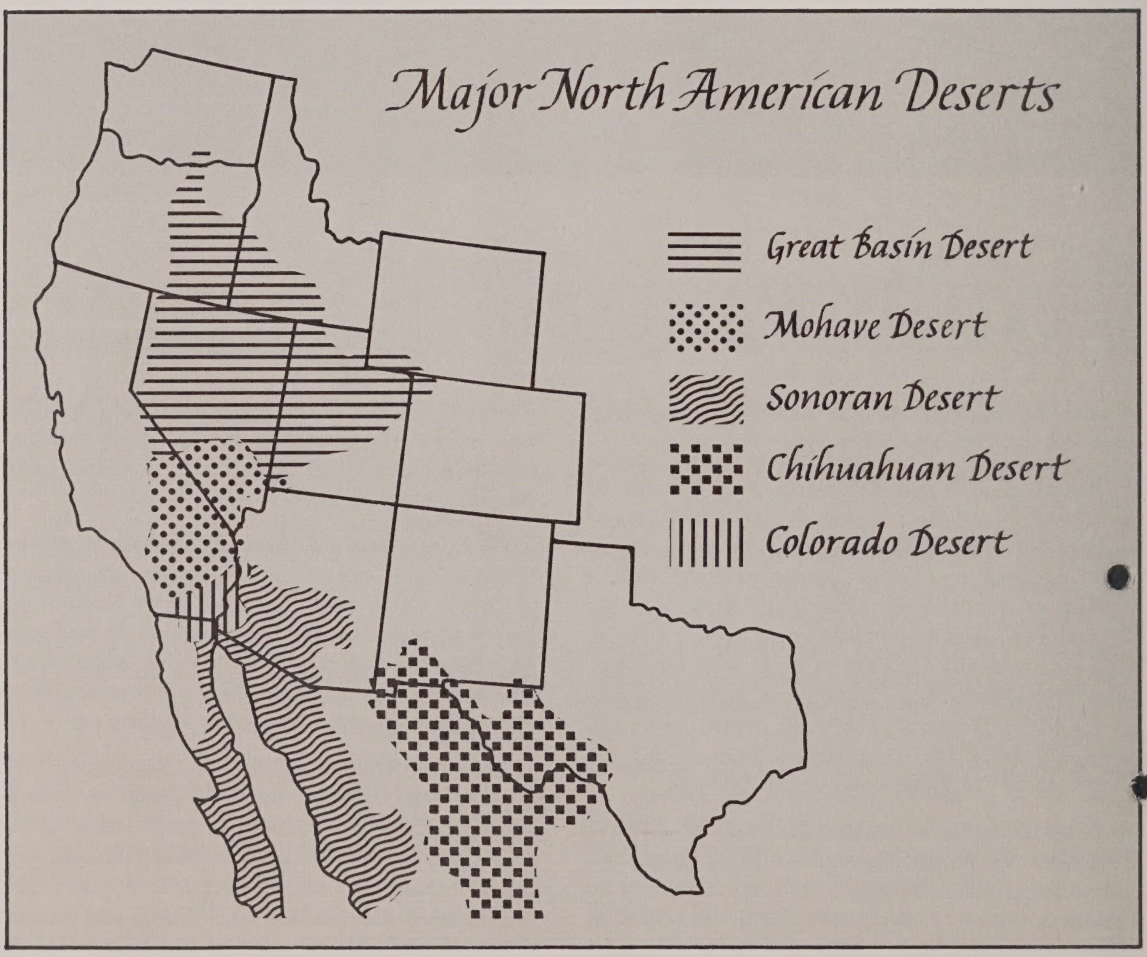
lizards and most birds; but even these tend to seek shelter from the heat of the midday sun.

Heat and drought are the same the world over and seem, curiously, to result in the development of similar characteristics in different species of desert plants and animals living on different continents. Cacti, for example, are native to the new world; however, in Africa some species of the unrelated family of plants called Euphorbiaceae have evolved physical adaptations so similar to those of cacti that it can be difficult to tell them apart. Desert birds and mammals have also developed comparable traits. Some species of African/Asian gerbils are look-alikes for American kangaroo rats, right down to the markings on heads and tails.

Major deserts exist on most continents; but the African Sahara is the largest on earth. Its 3,320,000 square miles represent almost 29 percent of the continent. Overall, deserts cover almost 12 percent of the earth's surface, an area equal to the continent of South America. In North America, however, deserts make up only 2 to 3 percent of the land. But in spite of this proportionately small area, American deserts exemplify a wide spectrum of conditions found in deserts around the world. The ultra-dry, scorching Death Valley and Colorado Deserts are quite similar to parts of the Sahara, while the dry-cold desert of eastern Washington State is similar to some sections of Asian deserts.

There are five major North American deserts: the Great Basin, Mojave, Colorado, Sonoran, and Chihuahuan Deserts. Covering most of the states of Nevada and Utah, the Great Basin also extends slightly north into Oregon. The Mojave Desert, containing the barren Death Valley, spreads over the southern tip of Nevada and into the eastern edge of California, while to its south lies the Colorado Desert. This latter desert borders, in turn, on the Sonoran Desert of southwestern Arizona, northern Mexico, and California's Baja peninsula. Southwestern Texas and southern New Mexico share the shrub Chihuahuan Desert with northeastern Mexico.

Each of the five deserts has its own characteristic climate and topography, resulting in an extremely large diversity of plants and animals. In fact most American deserts harbor a much greater



diversity of species than do many temperate forests. In the Great Basin, for instance, seven species of nocturnal rodents are commonly found together; whereas in a coniferous or deciduous forest, it would be unusual to observe more than three or four species in one habitat.

Most of the range of the Great Basin, our largest desert, extends over areas of relatively high altitude. Its most famous feature is the Great Salt Lake, a remnant of the Ice Age, practically devoid of life because its salt content is almost ten times that of the ocean. Salt bush (*Atriplex spp.*) is probably the most characteristic species of the region—a plant from which one species of kangaroo rat has developed the ability to remove the leaves' high salt content surface tissues in order to obtain food low in salt and high in water. In the north, the extensive Bonneville salt flats are almost totally devoid of plant life because of the soil's high salt content.

The flora of the Mojave, which abuts the Great Basin, differs greatly. Characteristic of the area, the creosote bush's regular spacing on the desert floor gives the terrain its unique appearance. The spaces between the bushes are apparently the result of toxic chemicals exuded by the plant's roots to insure that nothing else will grow too closely and compete for the scarce supply of water. Rich flora and fauna, augmented by major flights of migratory birds, typify most of the Mojave. On the other hand, Death Valley, probably this desert's most well known landmark, is ultra dry, with temperatures commonly approaching 125°F.

Southeastern California is blanketed by the Colorado Desert, a small extension of the Sonoran Desert, which is nearly as hot and dry as Death Valley. Seventy-five years ago the Colorado River flooded the Imperial Valley forming the Salton Sea, which lies in the center of the desert. The sea now serves as a wildlife refuge and provides a wintering area for huge numbers of shorebirds, ducks, and geese. Stretching to the Mexican border, 40 miles long and almost 5 miles wide, the Algodones Dunes are an extensive sand dune system that rise as high as 300 feet.

Perhaps the most lush of all the North American deserts is the Sonoran, so rich in cacti that as many as 20 species sometimes grow in one location. The best known cactus is the saguaro, which reaches heights of 40 feet with stem diameters between 12 and 25 inches. A source of food for several species of desert birds, saguaros are also used for nesting by many birds. The Papago Indians harvested the saguaro's fruit, both to eat fresh and to turn into syrup and cakes.

A tremendous variety of reptiles, birds, and mammals flourish in the Sonoran. In southeastern Arizona, the desert is scattered with rich oases, which act as islands for some of the more tropical animals from Mexico, like the javelina (peccary) and raccoon-like coatimundi. Rare zone-tailed gray and black hawks sometimes hover above the hills near these canyon oases. On the sides of the saguaro-covered hills a very lucky and careful observer may see the only venomous lizard in the United States—the large, beautifully colored Gila monster.

As one moves east into New Mexico and Texas, the composition and structure of the desert changes. This is the Chihuahuan, a shrub desert, rather similar to the Great Basin. Desert grasses, quite unlike those of the midwestern prairies, flourish in the high elevations of this land—a transition between the short grass plains and desert shrub habitat of lower elevations. Because it is relatively isolated from the other North American deserts, the Chihuahuan appears to harbor more endemic varieties of plants and animals.

The diverse ecosystems of the southwest are perhaps the most fragile systems on the North American continent. To survive, desert plants and animals have made, over long periods, unique adaptations to their environments. But in spite of these adaptations, life in the desert is so stressful that the fauna and flora are especially vulnerable to any added disruptions. For instance, extremely slow growth rates are typical of all perennial plants of the desert. Therefore, once damaged, cacti and shrubs may take tens of years to recover, if indeed they ever can. Going a step further: If shrubs that formerly stabilized a dune are damaged, the dune may become unstable and spread over a large area, covering large numbers of neighboring plants and destroying viable habitat for years to come.

People have intruded on the fragile deserts in every way possible—with sprawling housing developments and tourist resorts that cover and destroy the desert and deplete the land of its meager, vanishing water supplies. Collectors rob the deserts of their vital flora and fauna, and users of off-road vehicles damage the land in their search for recreation. An even greater threat is the presence of cattle and other hoofed stock which, in many areas, have decimated the plants and completely changed the character of the ecosystem. All these threats make it mandatory that the natural biological diversity of America's vast, fascinating desert ecosystems be protected in major preserves and natural areas.

Dr. Gerald Lieberman has spent many years conducting research on the rodents of American deserts. He is a past employee of The Nature Conservancy's Science Department and is currently a consultant with Environmental Systems Associates, Inc.

Our Disappearing Desert Fishes

by David L. Soltz

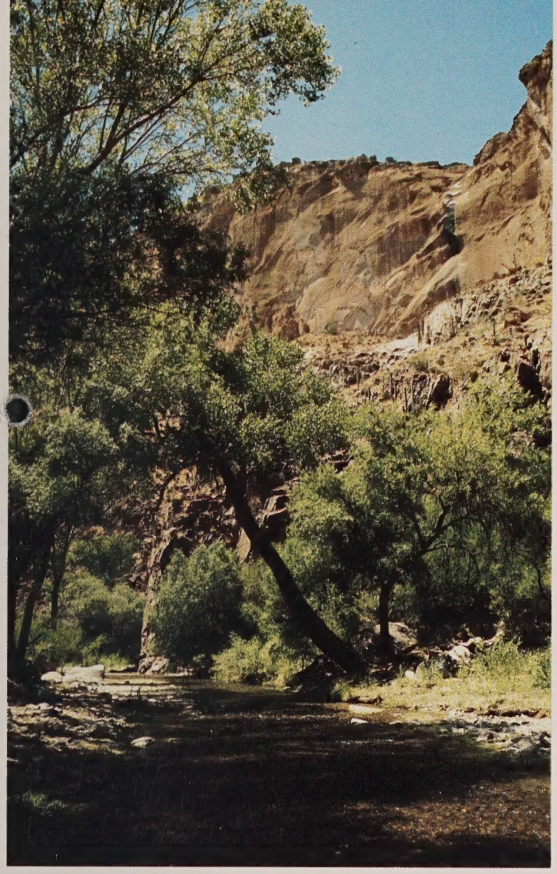
Deserts with aquatic habitats and fish? It seems impossible but, even in places as arid as Death Valley, green patches on the horizon indicate areas where the water table is near the surface along faults or over impermeable clay or rock strata. In these isolated springs, streams, or marshes, fish have managed to persist and even flourish in the midst of the sun-baked desert. The life history of some of these fishes is a fascinating story.

At the end of the Pleistocene Epoch, 10,000 to 20,000 years ago, the glaciers that covered much of North America receded for the last time. The southwestern portion of the continent, although untouched by glaciation except in some of the highest mountains, was much cooler than today and surface water was abundant. The Colorado River drainage was tremendous, cutting the Grand Canyon as it rushed to the Gulf of California. The State of Arizona was criss-crossed with the Colorado's tributaries, such as the Gila, Salt, and Bill Williams Rivers. There were myriad internal drainages containing lakes that are now the dry valleys of the Great Basin. Lake Manley, receiving water from the Owens, Amargosa, and Mojave Rivers, formed in Death Valley. At its maximum extent, Lake Manley filled the valley to a depth of over 650 feet. Fishes were surely widely distributed within and between these drainage systems.

About 10,000 years ago a drying trend began. The major lakes and rivers today are greatly reduced and most aquatic habitats have dried completely. During this time the deserts of the American Southwest formed. A few large rivers, like the Colorado and its major tributaries, persisted. However, most waters shrank away leaving only isolated, small streams and springs as refuges for remnants of the once abundant aquatic life.

Today, these isolated springs and streams are "islands" in a "sea" of desert. The many distinct species and subspecies of pupfish and killifish that have evolved in isolated aquatic islands of the Death Valley System provide scientists with a small scale natural laboratory similar to the Galapagos Islands that so strongly influenced the thinking of Charles Darwin. Today there are more than 20 populations of pupfish in the Death Valley System that have evolved into 10 distinct species or subspecies. Each species of pupfish has taken on a distinct shape and marking as well as a unique set of biological adaptations.

The pupfishes of the Death Valley System are an example of the differentiation and evolution of desert fishes. Ancestral pupfish presumably inhabited shallow lake margins, marshes, and streams where environmental parameters (temperature, salinity, dissolved oxygen, etc.) fluctuated daily and seasonally. These pupfish were probably highly variable in character and were able to withstand wide environmental extremes. Today some Death Valley pupfish populations are isolated in extremely variable environments, like the Amargosa River and Salt Creek. Others are isolated in stable springs with constant temperature, such as Devils Hole, School Spring, and The Nature Conservancy's Big Spring. In isolation there is no interbreeding between populations, and selection pressures of the different environments gradually act on the genetic make-up of populations. Slow evolution into different species and subspecies results, with each species adapted to a specific isolated habitat. The most divergent pupfishes of the Death Valley System are those isolated for the longest periods (more than 10,000 years). The Owens pupfish (*Cyprinodon radiosus*), found most distant from the center of pupfish distribution, and Devils Hole pupfish (*Cyprinodon diabolis*), existing in a higher, inaccessible habitat, are two such examples. In contrast, Amargosa pupfish (*Cyprinodon nevadensis*) habitats have been intermittently connected, reducing the length of isolation to spans ranging from 400 to 5,000 years. Consequently the Amargosa pupfish



A variety of desert aquatic habitats: Arizona's pristine Aravaipa Creek (left) supports the most diverse native fish community in arid Southwest country; extremely isolated and variable, Salt Creek in Death Valley (bottom) lies some 200 feet below sea level and harbors few fishes; Big Spring, Nevada (below)—a large, clear thermal pool within a Conservancy preserve—provides habitat for the Ash Meadow pupfish and speckled dace.

has changed less than others, evolving into several subspecies but not into distinct species.

The unique quality of desert fishes stems from their isolated evolution in a harsh desert environment. Each species or group of species has adapted to its specific aquatic world, which varies widely in the few remaining lakes, in rivers like the Colorado, in the abundant streams of Arizona and New Mexico, in marshes, or in the springs of California and Nevada.

Of the lakes, very few persist today. A rare habitat like Pyramid Lake in Nevada should act as a refuge for some of the large species of fishes that were widespread during the Pleistocene. Unfortunately, a dam built for irrigation and the resultant lowering of Pyramid by almost 100 feet has long since ended the spawning runs of Lahontan cutthroat trout (*Salmo clarki*). Two other, once abundant fish—the tui chub (*Gila bicolor*) and the endangered cui-cui (*Chasmistes cujas*)—have been nearly wiped out of the lake by loss of spawning and feeding habitat.

The lower Colorado River and a major tributary, the Gila River, were naturally turbid, strong-flowing rivers varying tremendously with the seasons and supporting vast marshes along their courses. Their fast-flowing, gravel-bottomed main channels supported a number of large, specialized fishes of the minnow (*Cyprinidae*) and sucker (*Catostomidae*) families. Most spectacular of these is a huge minnow, the Colorado River squawfish (*Ptychocheilus luceus*), a giant predatory fish, known locally as the Colorado salmon, that used to reach a length of 6 feet. They lived and spawned in the deepest, swiftest portions of the main river channels.

Several Colorado River fishes have an unusual adaptation—an extremely pronounced hump on the dorsal surface immediately behind the head, which allows them to stay in position on the bottom while feeding in fast water. The hump acts as a barrier to passing water, forcing the fish's body against the bottom. This bizarre adaption is best developed in the humpback chub (*Gila cypha*) and razorback sucker (*Xyrauchen texanus*).

The Colorado River has been altered drastically by a series of huge dams constructed for water diversion and hydro-electric power production. Today the river and its tributaries are essentially channelized canals, with greatly reduced flows, lacking seasonal variation but receiving abnormally cold water released irregularly from the bottom of reservoirs. Virtually the entire lower Colorado is now nothing like the natural environment in which its fish communities evolved. Miraculously none of the native fishes have been totally exterminated, though all native fish populations are greatly reduced. Some of the larger species are on the verge of extinction, two are officially endangered species, and most are confined to the few remaining areas that have nearly natural feeding and spawning conditions in the Grand Canyon and some portions of the upper river basin.

The Colorado River originates from high elevation, crystal-clear, cool tributaries that do not support the desert species. Many of these headwaters are isolated in mountain islands surrounded by desert and often support native trout. These trout are probably derivatives of the once widespread cutthroat trout. Many of them have evolved brilliant colorations. Several "desert trout" populations are threatened by water diversion and hybridization with rainbow trout which ill-advisedly have been introduced into many isolated mountain streams for sport fishing. Some "desert trout" are already gone and others probably will be lost.

Most fish in the southwestern desert today live in small streams that are common in the Death Valley System and throughout Arizona and New Mexico. Desert streams are variable and unpredictable, drying during summer to a series of disconnected pools, swelling in a few hours to the flash floods for which the southwest is famous. Flooding is disastrous to fishes and aquatic invertebrates, particularly the smaller ones, battering and isolating them downstream away from their chosen homes or in side pools that evaporate when the flood recedes. Disaster comes very quickly. After one day of rain in September 1972, the Amargosa River rose from less than a 1-inch trickle through a road-crossing culvert to a torrent that completely washed out the road. Interestingly, the fishes often balance these flood disasters with immediate spawning. I have seen the Amargosa River teeming with young pupfish two weeks after a flood.

Desert stream-dwelling fishes must also adapt to variations of temperature, salinity, and dissolved oxygen. Streams in the Death Valley System vary seasonally from 32° to 113°F. Furthermore, in the summer the water temperature can rise or descend in one day by as much as 45°F. Salinities can vary from pure fresh water at some stream origins, to more than twice the salt content of seawater downstream and in side pools. Dissolved oxygen concentrations in the water often drop below 1 part per million and can reach zero on hot summer nights in highly productive desert streams. Death Valley pupfishes inhabit what are probably the most stressful stream environments and are able to tolerate briefly temperatures as low as 33.7° and as high as 107.6°F, salinities to about 70 parts per thousand (twice seawater), and dissolved oxygen concentrations as low as 0.5 part

per million. These abilities are records for freshwater fishes.

Extremely isolated and variable streams, such as Salt Creek on the floor of Death Valley at 181 to 229 feet below sea level, contain few fishes. The creek supports a single endemic species, the Salt Creek pupfish (*Cyprinodon salinus*). The somewhat more benign habitat of the Amargosa River supports two native fishes, a subspecies of Amargosa pupfish, and a population of the widespread speckled dace (*Rhinichthys osculus*). The desert stream with the most diverse native fish fauna is Aravaipa Creek in Arizona, which supports a seven-species fish community. The prime habitat surrounding the stream, Aravaipa Canyon, was purchased by The Nature Conservancy and was transferred to Defenders of Wildlife, which now manages the area. Seven native fishes, five minnows and two suckers, coexist in the pristine stream by segregating into different feeding and habitat niches. Aravaipa Creek largely has been spared from the usual problems of water diversion and introduction of exotic predatory or competing species. It is one of the few remaining examples of the complex fish communities once characteristic of Arizona streams. Two of the seven fishes in Aravaipa Creek are groups endemic (evolved in and restricted to) the Gila River System: spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*). Two other Nature Conservancy preserves in Southern Arizona, Patagonia-Sonoita Creek Sanctuary and Canelo Hills-Cienega, also contain relatively undisturbed, native fish communities.

Edged with salt crystals, Death Valley's unusual Cottonball Marsh is alive with its own rare species of pupfish.

Marshes, once common but now rare, are characteristically shallow, variable habitats with dense growths of emergent vegetation, which provide fish habitat similar to that of small streams. One incredibly different marsh habitat is Cottonball Marsh, lying in the barren salt pan of Death Valley at more than 260 feet below sea level. Here, one endemic fish, the Cottonball Marsh pupfish (*Cyprinodon milleri*) lives in a few permanent pools and channels. This aquatic habitat is surprisingly moderate (salinities to 45 parts per thousand and temperatures to 96.8°F), considering that air temperatures to 122°F cause salts to crystallize at the edges of the pools. Although this pupfish is considered a rare species, it is well protected by its remote location within Death Valley National Monument.

Thermal springs abound in the Death Valley System. The warm clear pools teeming with pupfish are particularly abundant in Ash Meadows, Nevada. A series of large springs contains the Ash Meadows pupfish (*Cyprinodon nevadensis mionectes*) and speckled dace. Big Spring, one of the largest and most beautiful of these springs, is part of a 397-acre Nature Conservancy preserve that also protects several rare, endemic species of wildflowers.

Isolated at a slightly higher elevation is a series of six small, warmer springs inhabited by the endangered Warm Springs pupfish (*Cyprinodon n. pectoralis*). Devils Hole, a warm, 93°F pool with no outlet, lying about 50 feet below the surface of the earth in a fault fracture on the side of a hill in central Ash Meadows, is inhabited by the endangered Devils Hole pupfish. This pupfish has evolved in probably the most restricted and isolated habitat of any fish in the world. It is the smallest of all pupfish, lacks vertical side markings, has completely lost the paired pelvic fins, is non-aggressive, and does not exhibit the characteristic pupfish breeding territoriality.

Sadly, almost all desert fishes have suffered greatly from disruption and destruction of their habitats. Twenty-one of the 23 endangered species of fishes in the United States live in desert areas. Native fish habitats have been lost because their waters have been reduced, either by diverting the surface water or by mining the groundwater. Fish populations have declined or disappeared because exotic, non-native fishes and other organisms, which are predators or competitors, have been introduced.

Diversion of surface water has taken a tremen-

dous toll on desert fishes. Virtually every desert stream-dwelling species has been eliminated from part of its native range. Many species are listed as endangered because of this type of habitat loss. They include: Owens pupfish (*Cyprinodon radiosus*) in Owens River, California; woundfin (*Plagopterus argentissimus*) of the Virgin River; Moapa dace (*Moapa coriacea*) in Moapa River; and Colorado River squawfish and humpback chub, both of the Colorado River. Extensive loss of marsh habitat combined with predation by introduced game fishes has extirpated the Desert pupfish (*Cyprinodon macularius*) from the entire Colorado River.

The lowering of water tables by mining of groundwater can also be devastating. The endangered Pahrump killifish (*Empetrichthys latos*) no longer exists in its native Pahrump Valley where all of the springs have gone dry following attempts at residential development. Major agricultural development in Ash Meadows starting in 1969 resulted in rapid reduction of spring flows and disturbance of fish habitat. The water level in Devils Hole, the only habitat of the endangered Devils Hole pupfish, was directly lowered by pumping of wells. The shallow limestone shelf upon which the small Devils Hole pupfish population depends for food and spawning was progressively exposed. The National Park Service sued (Devils Hole has been an annexed part of Death Valley National Monument since 1952), claiming a prior federal water right that ensured the survival of this small fish. The six-year legal battle culminated with the 1976 U.S. Supreme Court decision recognizing the National Park Service's water right and guaranteeing a water level in Devils Hole that will support a stable population of pupfish.

The Ash Meadows pupfish is one of the many distinct subspecies which have evolved in the scarce, sequestered waters of the Death Valley System.

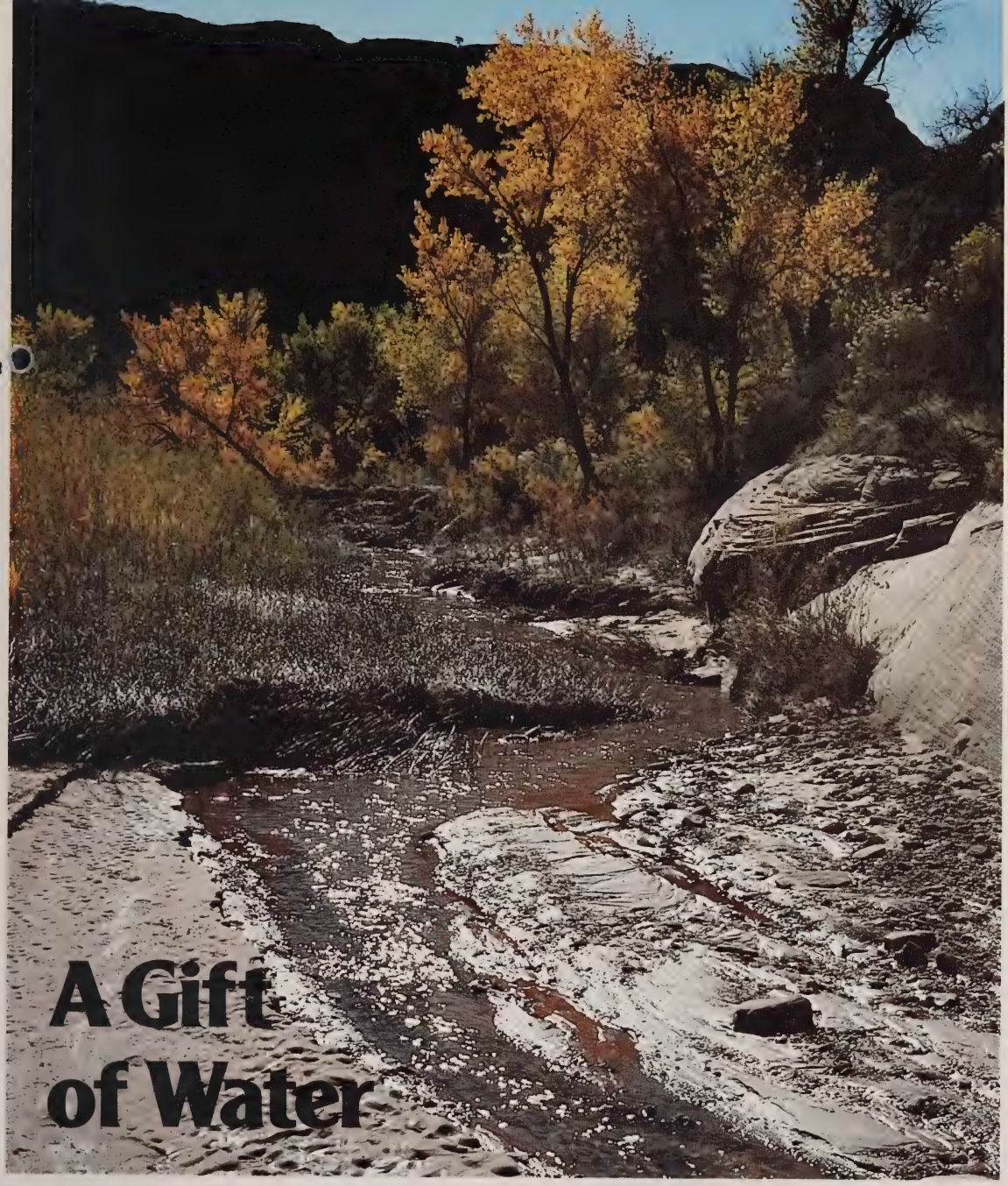
Introduced exotic species often wreak havoc on simple desert fish communities where native fishes have had few if any predators or competitors. Competitors are sometimes less immediately threatening than predators, like the bass that have decimated the desert pupfish. Yet introduction of competitors is more common and always leads to the decline of the native fishes. The extinct Ash Meadows killifish (*Empetrichthys merriami*) was never common and was last seen by scientists in Big Spring in 1948, several years after the introduction of mollies (*Poecilia sphenops*) and mosquitofish (*Gambusia affinis*). The decline and destruction of several populations of Gila topminnow (*Poeciliopsis occidentalis*) were due to competition from introduced mosquitofish.

A different sort of threat to desert fishes occurs when closely related non-native species are introduced and crossbreeding occurs. The two native desert chubs in California, Owens chub (*Gila bicolor snyderi*) and Mojave chub (*Gila b. mohavensis*), have hybridized throughout their respective drainages with the introduced coastal chub (*Gila orcutti*). Each subspecies now exists in only one isolated, genetically pure population.

The universal decline of fishes in all desert areas is more than the tragic demise of a few species—it signals the destruction of the desert's most precious resource: aquatic ecosystems. As long as the pressure of human expansion into arid areas continues, the demand for water will rise. We must act now to preserve desert aquatic habitats of fishes whose genes contain information that has been molded in the harsh and variable desert environment and the aquatic habitats in which they survive. Neither the fishes nor the habitats can be regenerated once they are radically altered or destroyed.

The key to survival of desert fishes is the preservation of *entire* aquatic habitats with an adequate water supply. The Nature Conservancy has made an admirable beginning with four preserves supporting entire habitats of desert fishes. Such acquisitions combined with major regional recovery plans—such as one to preserve adequate habitat for survival of the large fishes native to the Colorado River—must accelerate rapidly if desert fishes and desert aquatic habitats are to remain a significant part of the natural heritage of the American Southwest.

David Soltz is Associate Professor of Biology at California State University at Los Angeles. In addition to teaching ecology and ichthyology, he researches the community structure and life history of desert fishes. Dr. Soltz recently published *The Natural History of the Native Fishes in the Death Valley System* (Los Angeles County Museum of Natural History, 1978).



A Gift of Water

by Gail Schroeder

A verdant green artery of life pulsating through tawny hues of surrounding grasslands, dry oak-scattered hills, and arid mesquite flats. . . . This is the desert riparian woodland. It is a world of water-sustained, water-dependent life amid a parched landscape—a world comprised solely of narrow green threads winding through the massive brown tapestry of the Sonoran Desert of southeastern Arizona.

These riparian woodlands, or "oases," weave along the drainages in which semi-permanent to year-round waters flow, fed by adjacent mountains and natural springs. The reliability and permanence of these sources of water, in comparison to the biannual rainfall of the surrounding desert, has led to the evolution of a unique biotic community directly or indirectly dependent on the waters for sustenance and shelter. Even neighboring desert dwellers, well adapted to heat and drought, enter the green realm seeking respite from the heat and nourishment from the nondrying pools. The more moderate climate of the oases supports a greater

diversity and abundance of life.

Yet so narrow are these green threads of moisture in the vastness of the desert that the strands have become increasingly shorter. Because of human activities, the desert riparian woodland and the world it supports have become endangered. The Nature Conservancy, in attempts to save remnants of this unique and diminishing habitat, has preserved four such areas in southeastern Arizona.

Splashed with lush, broad-leaved, deciduous trees and dense thickets of shrubs and willows, Patagonia-Sonoita Creek Sanctuary, Canelo Hills Cienega, Ramsey Canyon/Mile Hi Ranch, and Aravaipa Canyon are oases of green in a dry land. My visits to these oases have been limited to midsummer days just before the season's rains broke. It was the best time to observe both the vital role of water in these unique desert worlds and the life hidden within them.

Patagonia-Sonoita Creek Sanctuary

Mesquite thickets, called bosques, dry and leafless, await the summer rains. A few dark-green leaves sprout among thorn-clad branches, the only sign of life amid the grey shrubs and brown grasses. The mesquite and grasses melt to a dusty road; the road drifts to mud, pocked with raccoon tracks and thick with watercress. The smell of alkaline sands, of dampness, cool, and shade are heavy on the air. As you walk farther, moving from dry to wet, sun to shade, heat to cool, and brown to green, within only a few yards you are absorbed by a different world, so abundant with life that it is almost tropical. This is Sonoita Creek, which flows year-round through the narrow floodplain of Patagonia, a stream-cut arroyo castled with towering cottonwoods. The 360-acre sanctuary is owned by the Conservancy.

In the midday heat, life slows to the undulating drone of the concealed cicada until midafternoon breezes stir the thick chandeliers of cottonwood leaves and gray undertones of willows lining the stream. Moisture-loving indicators, whose roots are basted in the mud and waters of the creek, the majestic cottonwoods hold a kingdom within. Orioles, flycatchers, and grosbeaks nest among leafy thickets; green curtains conceal the stick-built platforms of the gray hawk and other birds of prey. In summer months some 20 species of flycatchers perch on the exposed limbs.

Beneath the peeling gray and stringy bark of the cottonwoods dwell earwigs, beetles, and woodlice. The gray cortex is further scored by sapsucker hieroglyphics, as the birds forage for sap and insects. Titmice, wrens, and several woodpeckers—flickers, red-shafted and gilded, Gila, ladder-backed, and acorn woodpeckers—all stuff their downy young with the bark-shrouded insects of the cottonwoods.

In the shallows and along the water's edge stand miniature forests of rushes and grass, with thickets of watercress and mint, stands of cattail, and bouquets of yellow monkey flowers and delicately striped Veronica. Among these plants prowl tiger beetles and toad bugs, while the more stationary hunters, the spiders, wait in silken strands. Lady beetles, plant bugs, crane flies, flower beetles, butterflies . . . a host of insects to attract many of the 200 bird species that are inhabitants, seasonal residents, or migrant visitors of Patagonia. Many come from the heat and humidity of Mexico, some breeding far north of their usual range. The gray chilliness of northern winters sends many species south to this mostly snowless refuge. Others simply are nourished by the cornucopia of food and water as they migrate over thousands of desert miles.

Wild rhubarb and sow thistle crowd the banks of Sonoita Creek and hundreds of hand-high cottonwood saplings choke the shallow, slower-moving water. (Most of the saplings will be washed away with the cumulative torrents of the coming rains and the stream channel will be water-swept and cleansed.) The pools of these slower waters, veiled with scarves of yellow-green algae, are home for many of the insect larvae whose adult forms fill the bellies of both young and adult birds.

At the edge of the pools strut great-tailed grackles, long-legged and officious, in search of insects. Refined in their iridescence, bronze-headed cowbirds descend to drink, drawn also by the rich number of oriole nests in which they can deposit their camouflaged cowbird eggs. Lesser goldfinches bathe in the pools' waves; barn swallows swoop to skim the water's surface, drinking on the wing. A killdeer alights with shrill cries. A near-water dweller, she is here in the desert only because of the flowing waters of Patagonia-Sonoita. Fourteen species of fish are found in the creek; six of these are native, and all are food for the belted kingfisher and the rare green kingfisher from Mexico.

As the afternoon lengthens, the wind picks up. Crickets, grasshoppers, and katydids join the cicadas. The orchestra is soon dominated by the more musical strains of birds. More familiar to the cooler deciduous woods and coniferous slopes of the mountains, a speckle-breasted young robin sings loudly from a cottonwood perch. Yellow-breasted chats whistle in hoots and grating chatter amid the thickets of willow, walnut, and ash. Their notes are accompanied by the rattlings of yellow-throats. Both are large warblers of Patagonia. The rarer yellow-billed cuckoo gives loud tell-tale cries, but remains hidden. Hummingbirds dart to and

The hognose skunk, an oasis night-hunter, dens in cliff crevices.

fro, nectar-feeding, web-collecting, and nest-building.

Evening descends with all its moods of light, shadows, wind, and coolness. A kestrel hovers over the meadow. Poison hemlock thickets rustle with the activities of meadow mice, voles, and other rodents—food for many hawks and nocturnal hunters like opossums, raccoons, foxes, skunks, bobcats, and coyotes. The eared silhouettes of great-horned owls already perch alert in the cottonwood branches. Frogs are strangely quiet, awaiting the rain and the greening of their surrounding world.

Canelo Hills Cienega

The clouds have built up over Canelo, the sky angry gray with thunder. The light is soft on the grasses and trees of the oasis—a pool of green, radiant life, amid dry oak-junipered hills. Similar yet different, Canelo perhaps suggests Patagonia in its more virgin, mesic origins.

The 60-acre sanctuary encompasses a cienega, or marsh—a desert streamside grassland nourished by the waters of O'Donnell Creek. From distant mountains the creek takes an underground course and surfaces at Canelo to flow slowly through grass-sedge meadows and quiet thickets instead of the cottonwood galleries of Patagonia's deeper cut arroyo.

Here the waters flow silently from sedged flats to narrow channel, the course enshrouded by thickets of willow, walnut, and ash, with curtains of wild grapes and currants, ripe with purple and gloss-red berries—food for birds, coyotes, raccoons, and others. The water trickles in small falls into moss-lined, brown-bottomed pools, rich with leaf decay and all the smells of a clear mountain stream. Fish swim within a mosaic of light, shadow, and leaf patterns. Trampled grass tells of deer, skunks, coatimundis, rabbits, and coyotes. Pewees, chats, cuckoos, and warblers call from the dense green thickets, heard but unseen. Buttercups, red penstemons, and blue-eyed grass speckle the more open edges of the thickets. After the rains wildflowers bloom in profusion. The branches of evergreen Engelmann oaks touch fingers with the lush ash and willows of the stream. Beneath this canopy flourishes a unique mixture of violets, neighbors of agave, *Mammillaria* cacti, and green-lichen-blanketed volcanic rocks.

The bird life of Canelo Hills is varied, some 120 species. As in Patagonia, the uncommon summer residents from Mexico find habitat in which to breed, and northern visitors like the marsh hawk, crossbill, and goshawk wait out the winter. A solitary large cottonwood housing hawks, woodpeckers, and flycatchers stands sentinel at a small dam, built to check the erosion of the creek bed during torrential rains and, thus, to preserve the marsh habitat. Swallows skip and glide above the dam-created pool, and bright orange dragonflies patrol the pond in company with the more delicate blue damselflies. As a red-wing blackbird calls from a bordering clump of cattails and bulrushes, a black-chinned hummingbird hovers to drink. Cottonwood leaves scatter in accompaniment to the clap of thunder; nighthawks dance against the gray-dusk sky, and here, too, the land waits for the rain.

Two Canyons

A few drops of rain, and the overpowering scent of water on sandy earth is carried for miles on desert winds. Nevertheless, the stream of Ramsey Canyon flows continuously, not dependent on seasonal precipitation. The canyon is a refuge for many creatures unable to tolerate the surrounding aridity, as well as for species from higher elevations that find suitable coolness in Ramsey.

As Ramsey Creek descends through the canyon, the sound of running water is conspicuous. With leaves like drooping green gloves, the moisture-loving sycamores are dominant, instead of cottonwoods. Willows, ash, walnut, and maple tunnel the stream. Rare Mexican transients, the sulphur-bellied flycatchers wheeze and scold loudly. Summer tanagers, many hummingbirds, rare birds of prey, and coppery-tailed trogons also from south of the border, reside or nest within the canyon's borders. Rattlesnakes, including three species on Arizona's rare and endangered list of wildlife, also live in the area.

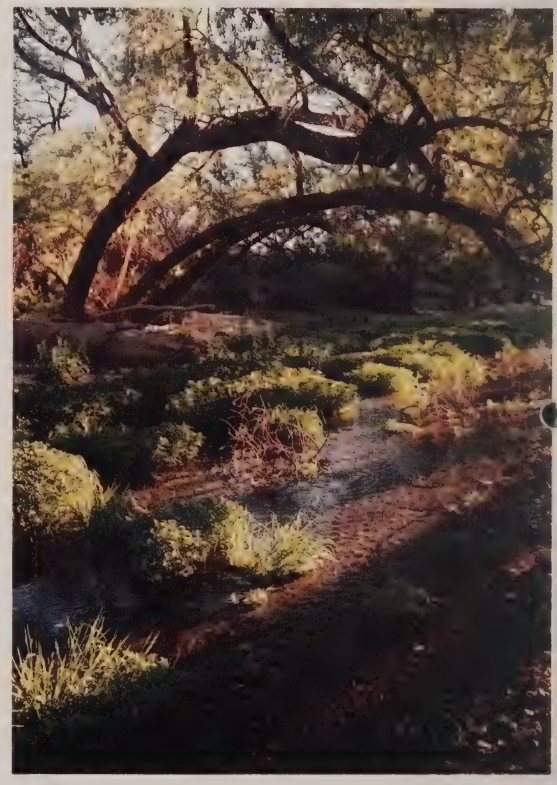
Oaks, distinctive alligator-barked juniper, bayonet-like yuccas, and granite boulders descend Ramsey's slopes to the stream's edge. Only a few feet away, a whiptail lizard, handsomely jailed in yellow stripes, laps last night's raindrops from a cupped leaf. Waving their fur-gray tails, Huachuca squirrels search for last year's acorns. Periwinkle chokes the banks of Ramsey Creek, and asters and sunflowers attract dancing, unsuspended mobiles of butterflies—admirals, swallowtails, and blues.

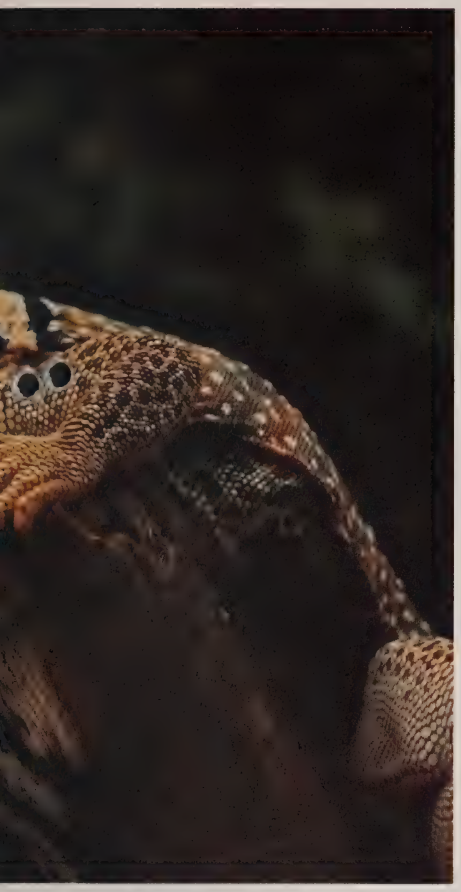
Managed by the Conservancy, Mile Hi Ranch is the focal point of Ramsey Canyon. People come from all parts of the country to see the canyon's hummingbirds—some 15 species—which are attracted to the ever-full bottle feeders near the Mile Hi cabins. Eight hummingbirds nest within the canyon, including the rare violet-ear, making

Ramsey one of its two known U.S. breeding sites. People sit and watch, fascinated by the tiny birds, marveling at their scintillating colors and agility, aware of their rarity.

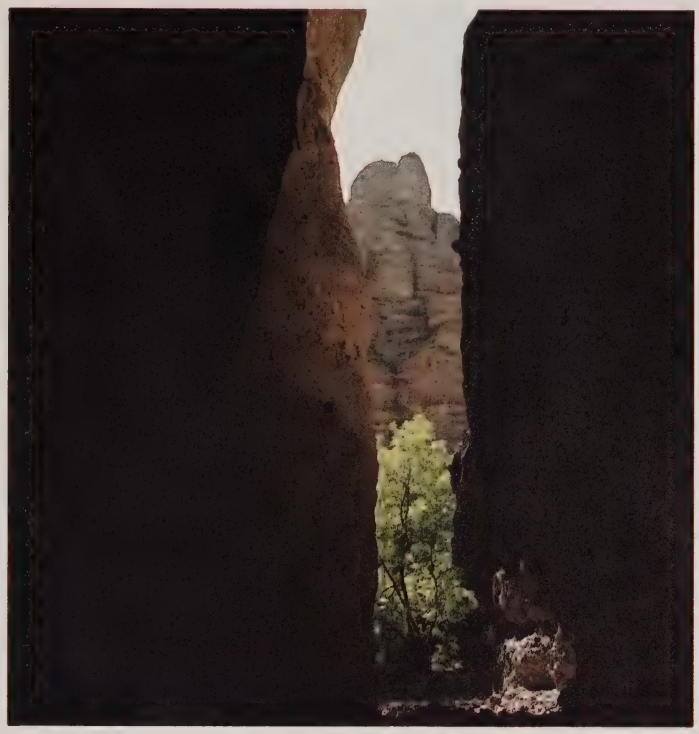
To the north of Ramsey Canyon and Mile Hi lies another "canyon-oasis"—Aravaipa. Also a permanent stream, Aravaipa Creek cuts through the dry desert slopes of paloverde, saguaro, and cat-claw acacia. Its waters originate from distant pine-forested mountains, retreat underground, and resurface within the canyon. Here the creek paints a 20-mile slash of green through Aravaipa's red rock walls before disappearing once more beneath the desert sands.

A rich cottonwood-dominated riparian habitat, Aravaipa Canyon, now overseen by Defenders of Wildlife, is a refuge for mountain lion, golden eagle, prairie falcon, black hawk, zone-tailed hawk, gray hawk, and others. A reported 139 species of birds visit or reside in the canyon—even the dipper, or water ouzel, and winter wren of mountain streams and forest find shade and sustenance in





Far left: desert opulence—a Rivoli's hummingbird sups on nectar; left: the rock-dwelling collared lizard; lower left: cottonwoods and willows edge the surprising waters of Patagonia's Sonoita Creek; below: greenery dazzled by a sun swatch among Aravaipa Canyon's red rock walls.



this verdant belt. Aravaipa's towering walls are also a sanctuary for mothering Mexican leaf-eared bats, which birth and nurse their young in the canyon—the only known U.S. maternity colony of the species.

The hills above Aravaipa Canyon harbor desert life of their own. Brittlebush, ocotillo, barrel cacti, fairy duster, and an array of desert wildflowers bloom with the rains. The seasonal showers also bring torrential flood waters that further carve the canyon, sweep clean the debris and cause changes —a natural cycle brought on by the rains that are necessary for a thirsty desert.

But change to riparian woodlands is not and has not always been natural. Water courses have been diverted and water tables lowered for the needs of only one species, humans, leaving drained basins and once rich green oases invaded by scrub. Cattle have denuded the land of its thick cover of grasses, causing the once life-giving rains to carry away the topsoil in torrents and flash-floods. The willow, ash, and cottonwood, the thickets of grape and virgin's bower no longer find foothold along a permanent water course. Without shelter and nourishment, the avifauna, mammals, reptiles, and insects disappear. Fish not exterminated by the draining of their waters either face an onslaught of introduced species or choking organic wastes.

Desert riparian habitats, oases of green: so few exist in the vastness of intense heat and drought. They hold the life-giving gift of water, a gift often misused, rechanneled for human purposes. I can continue to describe the uniqueness of eternal waters, to explain how essential these oases are in a parched land that must wait for the rains. It may not matter to many if the dragonfly's dance is cut short, the birds' songs are silenced, the cottonwoods are lost, and the waters slowed to a trickle. These words may fall on deaf ears.

But anyone who has roamed the shades of these few green realms in the mid-summer desert heat, smelled their dampness, heard their songs, listened to the wind in the cottonwoods will understand without reasons. They have been touched with a sense of appreciation, wonder, and respect, as well as by a great gnawing fear for what may still be lost, mingled with hope for what has been saved.

Gail Schroeder is a naturalist who has studied and worked in the deserts of the southwest since she was a child. Currently living in her native California, Ms. Schroeder just returned from several years of field work in East Africa, where she studied baboons.

Tortoises for Tomorrow

by Kristin H. Berry

Although I grew up in the western Mojave Desert and had several desert tortoises for backyard pets as a child, we didn't really become acquainted until I was almost finished with graduate school. I was writing my dissertation on the ecology and social behavior of another long-lived desert reptile, the chuckwalla lizard, when the California Division of Highways asked me to take on their "Desert Tortoise Relocation Project." The project involved removing wild tortoises from a freeway corridor and locating new home sites for them. One thing led to another, and within a year, I was enmeshed not only in research on the behavior and ecology of wild tortoises, but launched on a campaign to preserve one of the prime remaining desert tortoise populations in the United States.

Tortoise History

The desert tortoise is a reptile of the arid lands in the southwestern U.S. and northwestern Mexico. It was once widespread in the southern deserts of California, extreme southwestern Utah, southern Nevada, and western Arizona. Until the 1930's and in some places until the 1950's, population densities of several hundred tortoises per square mile could be found in parts of its geographic range. Long-time desert residents in California noted extraordinary densities that could have been as high as 2,000 per square mile. Colbert Eyraud, now the owner of Cabot's Old Indian Museum near Palm Springs, remembers this era. He lived on a ranch in the western Mojave Desert when he was young, and travelled with his uncle to drill wells for water from 1921 to 1931. In those days he could find 20 to 30 tortoises within a half-hour. Toby Johnson, now a County Supervisor in Sacramento, spent the spring and summer of 1933 working as a recorder for the U.S. Geological Survey in Antelope Valley, when tortoises "were everywhere . . . all over the ground." He saw over 100 in one place at one time. Roberta Starry, an historian, author, and naturalist, recalls seeing 150 to 200 at one time in a small valley near her home in the western Mojave Desert in the early 1950's. Densities may have been over 2,000 tortoises per square mile in the Mojave.

Reports of high densities are not confined to California. In Utah Angus Woodbury and Ross Hardy began a ten-year study of the ecology of tortoises on the slopes of the Beaverdam Mountains in 1935. Their classic study cited densities of 150 tortoises per square mile.

All this has changed. Tortoise populations have been extirpated from many areas, and where they now occur, are generally in low densities of 5 to 50 per square mile. At this density, a person would have to walk all day to see two or three. Most populations with such low numbers cannot survive more than a few more decades. The numbers are just too low, with too few breeding females and too few young individuals.

In August 1978 the Office of Endangered Species (OES) of the Fish and Wildlife Service formally proposed the desert tortoise population in Utah for federal listing as an endangered species. At the same time, the OES requested a review of the population status in Arizona, Nevada, and California. Studies now underway indicate that tortoise populations in these three states probably qualify for federal threatened status. (Endangered means endangered with extinction; threatened means threatened with endangerment.)

Tortoise Sensitivity and Lifestyle

Tortoises have several life history characteristics and behaviors that make them susceptible to human activities. They are long-lived, reaching 60 to 80 or more years of age, and require a long period to reach reproductive maturity. Most wild tortoises don't breed until they are 15 to 20 years old. Once sexual maturity is reached, reproductive potential is low. Females lay from 4 to 12 or more eggs, each the size and shape of a ping-pong ball. They excavate a nest at the entrance to a burrow or near the edge of a shrub. The nest is then covered with sand and abandoned. Eggs are usually laid in late spring, from May through June, but not necessarily every year. The time required for

hatching depends upon the warmth of the nest. Eggs usually hatch after two to four months, but may take up to six months.

The little tortoises, which are called "hatchlings," usually emerge from the nest in fall. They must immediately find shelter from temperature extremes and predators. Very few live to maturity, perhaps only 2 to 5 out of every 100. The little tortoises are about 2 inches in length and very fragile. The shell is thin, like a human fingernail, because there is no underlying bone.

Many natural predators eat hatchlings and young tortoises. Snakes like the red racer, gopher, glossy, and Mojave rattlesnake easily eat these tender morsels. Roadrunners and ravens often peck open the shells and eat them. Desert kit foxes, spotted skunks, badgers, and coyotes can swallow them in one bite. Tortoises are somewhat less vulnerable after reaching lengths of 4 to 5 inches and 7 years of age. At that time, the bony skeleton has developed under the thin shell.

As the tortoise gets older, it becomes more resistant to predators. When it reaches adulthood, it is about 7½ to 8 inches in shell length and weighs 4½ pounds. At 40 to 60 years of age, it may reach a length of 14 inches and weigh over 17 pounds.

Even after attaining a large size, tortoises are not safe from predators. I have seen tortoise shells in golden eagle eyries and have found the fresh remains of tortoises killed by coyote and kit fox. But the reptiles have survived for millions of years with such predators. Predation is just another part of their life history.

Tortoises have been able to survive partly because of their habit of living in dens and burrows. The burrow shields the turtle from the extreme heat of summer and the below freezing temperatures of winter. Burrows provide a refuge from lack of moisture and protection from predators.

The burrows are easily recognized because they are half-moon in shape, just like the profile of a tortoise shell. Little tortoises have little, rat-like burrows, and the large tortoises have much larger burrows. The length of the tunnels varies considerably according to location. Burrows in the western Mojave Desert in California are generally no more than 10 feet in length, whereas those in Utah may be up to 30 or more feet and have several chambers and side tunnels. The greater tunnel length in Utah is probably associated with the colder, longer winters.

Much of the life of the tortoise is spent underground, perhaps six to nine months each year. Tortoises enter winter hibernation in September and October, and emerge any time from late February to early April. Emergence time depends upon local weather conditions. During spring, especially when there is a carpet of wildflowers, tortoises are active above ground, feeding, courting, and traveling. Retreat to the burrows comes with the onset of high summer temperatures. The summer period

Above, the rich and varied creosote scrub plant community of the Desert Tortoise Preserve in California's Mojave Desert sustains more than 200 tortoises per square mile. Right, tortoise courtship among the alkali goldfields: an aggressively amorous male bites the rear leg of his prospective mate.

A female desert tortoise basks in the sun before the arched entrance to her burrow.

of retreat and inactivity is called estivation.

Soon after leaving the dens in late winter, tortoises begin eating annual wildflowers and grasses. The wildflowers are the reptile's prime food in California, whereas grasses are more commonly eaten in Arizona and Utah. Flowers are available only for about three months. The yellow blazing stars, purple phacelias, pink gilias, orange mallows, and little white forget-me-nots are choice foods. Tortoises move through this smorgasbord of flowers, picking and choosing their favorites.

In years of drought, there is little or no fresh food, even in spring. Tortoises must eat enough during lush wildflower years to survive the droughts. During dry years, they spend most of the time underground, surviving on water and fat stored during more plentiful times.

Spring is not only the prime feeding time. It's also the time for socializing and traveling. Tortoises have definite activity areas or "home ranges." The size of the home range depends on a tortoise's size and sex. A little tortoise may have a small activity area with a radius of only 50 yards, whereas a large male may be familiar with and travel over a one-half-to a square-mile area. Females are more sedentary than males.

Threats to Tortoises

Threats to the integrity of desert tortoise populations and to habitat come from almost every source. Tortoises live in valleys and on slopes of mountain ranges, the areas most heavily used by people. Direct threats to their populations include vandalism, collections for pets, and commercial exploitation. Collecting for pets and for commercial sale was widespread and extensive for many decades. Undoubtedly it is responsible for lowering population levels in many areas, especially close to cities. All four states with desert tortoises now have some form of protective legislation, but a certain amount of illegal traffic continues.

Habitat deterioration and loss is by far the most serious danger to the desert tortoise. Agriculture, urban development, creation of dirt and paved roads, military maneuvers, off-road vehicle use, and mining and energy development all threaten the existence of these slow moving, shell-backed creatures.

Prime tortoise habitat has been cleared for agriculture and subdivisions throughout the Southwest, mostly near cities and towns. Not only have people cleared lands for their own use, but they have ranged out into the desert collecting tortoises. Domestic and feral dogs and cats also kill or injure the reptiles and destroy burrows within a radius of several miles from towns and ranches.

Dirt and paved roads, railroads, aqueducts and canals have accounted for millions of lost acres. But reduction of habitat is not the only consequence. Tortoises living adjacent to roads or railroads are killed during their travels. Recent studies indicate that populations adjacent to heavily-used paved roads may be depleted to distances of one-half mile on either side of the road. This may not seem so important, but there are often two miles of roads per square mile of prime habitat.

Most Americans are not aware that the desert was used by General Patton to train troops for the North African campaigns during World War II. Tank tracks criss-cross thousands of square miles of tortoise habitat in the Mojave and Colorado Deserts. The impact on tortoise and other animal populations must have been immense. Other major military operations also intruded on the reptiles' habitats in 1964 and 1976.

The impact of roads and trails on tortoise terrain is dramatically obvious, but the subtle effect of livestock grazing cannot be underrated as a danger. Cattle and sheep have browsed desert ranges since the 1850's in Nevada, Arizona, and Utah, and since the 1870's in California. Consequently, the land has deteriorated and is now in fair to poor condition. More than 90 percent of the land where tortoises make their home also provides food for livestock. In the resulting competition for food, burrows are trampled, young tortoises crushed, and habitat generally downgraded. A new handicap in the reptile's struggle for survival is the expanding feral burro population.

In the late 1960's another threat arose, one which literally has consumed hundreds of square miles of habitat—the off-road vehicle. In California, most prime habitat is used intensively by off-road vehicles, and—whether in the form of motorcycles, dune buggies, or 4-wheel drives—they have serious impacts on tortoises. Recreationists in these machines crush tortoises and burrows, damage the wildflowers, destroy shrubs used for shade, and compact and erode soils so that plants won't grow.

Saving Tortoises for Tomorrow

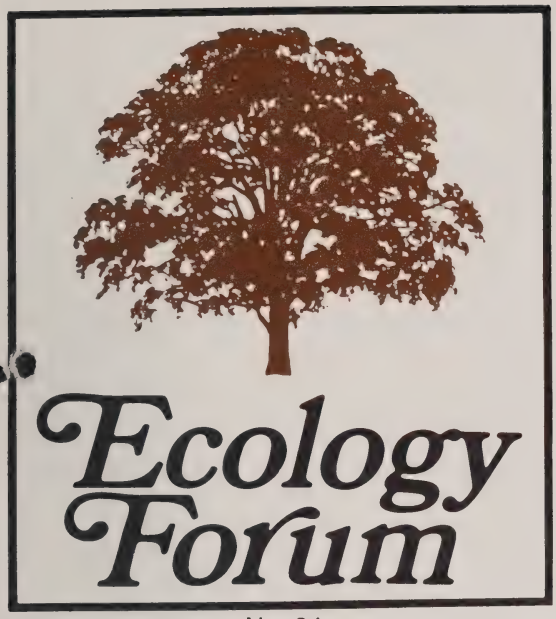
Tortoises, because of their sensitivity to environmental changes, are excellent indicators of the health of lowland desert ecosystems. Like the tortoise populations, these lands are gradually dying by fragmentation. Soon there will not be enough large blocks of relatively undisturbed habitat to support either the tortoise or other, larger species such as the kit fox, prairie falcon, and golden eagle.

There is some hope of preserving a small portion of prime tortoise habitat. In 1972 I asked the Bureau of Land Management (BLM), under the U.S. Department of Interior, to establish a preserve for the desert tortoise on the site of the highest known population densities. The area selected was one of the last remnants of a once widespread lowland Mojave Desert ecosystem that was besieged by competitive motorcycle racing, sheep grazing, and threats of agricultural and urban development. It contains the richest and most diverse creosote scrub plant community with over 160 plant species—a community that supports over 200 tortoises per square mile. It is home to the rare Mojave ground squirrel, desert kit fox, and many other small animals. The Bureau of Land Management responded a year later with a proposal to form a natural area on 30 square miles of mixed public and private properties, and closed the area to recreational vehicles.

In 1974, I and several other California desert residents formed the Desert Tortoise Preserve Committee in order to make this preserve a reality. We worked toward enlarging the boundaries to form a viable preserve and on raising funds for a fence and to acquire private land. Committee members also led tours, gave lectures, and developed interpretive materials for the preserve. In 1976, the Committee came under the wing of The Nature Conservancy as a project committee.

Seven years after the initial proposal, we are much closer to a viable natural area for the tortoise. The Bureau of Land Management has provided a woven-wire fence that almost completely surrounds the now 38-square-mile preserve. BLM will soon complete an interpretive center and nature walks. The biggest problem, land ownership, is still unresolved. Sixteen square miles are in private holdings and 22 are administered by the Bureau. The Committee and the Conservancy have raised funds to purchase 2¼ square miles, and the Conservancy has just assisted in a government land exchange to acquire another 2½ square miles. Eleven miles are left, and these remaining acquisitions are going to be long and difficult. There are over 400 property owners and most of the remaining parcels are quite small. Desert Tortoise Preserve Committee and Conservancy members look ahead to the day when the sanctuary is complete and the tortoise safe, in keeping with the motto on their T-shirts: "I may be slow, but I get there."

Lead Zoologist and Wildlife Biologist for BLM's California Desert Program, **Kristin Berry** is a dedicated conservationist. She is founder of the Desert Tortoise Preserve Committee, Inc., a member of the Board of Directors of the Conservancy's Southern California Chapter, and member of the Board of Directors of the Southern California Academy of Sciences. Dr. Berry was awarded a 1979 American Motors Award for her work with the desert tortoise and for her wildlife inventories in the desert.



No. 34
by Anne M. Byers
Staff Writer

AND THEY STILL SHOOT EAGLES, DON'T THEY?

In a year's time, from June 1978 to July 1979, Richard Countryman arrested 91 people, resulting in 37 convictions. He searched 283 vehicles and confiscated stolen items worth over $7,500. Sometimes fruitlessly, he has pursued culprits through desert sand storms; he once waited three hours in a chilling snow storm for a pick-up that never took place. Thanks to his efforts, Countryman accumulates from 100 to 150 threats to his life each year.

No, Richard Countryman is not a narcotics agent. He's most often called a "cactus cop"—a sleuth working for the Arizona Commission of Agriculture and Horticulture who, along with six other people, is trying to enforce Arizona's native plant law. Under the strict state law, a special permit is required to dig up any species on a list of 222 protected native plants, which includes all cacti in the state. The law prohibits removing cacti and certain other plants from any Arizona land without written permission from the landowner and a permit from the Commission. A fee must also be paid for each collected plant, which makes large-scale selling unprofitable. Violators can earn a year in jail and fines up to $1,000.

Unfortunately, enforcing the law is not an easy task. Permits are simple to obtain, and judges are often lenient with offenders. In addition, the six lone detectives are faced with the impossible chore of patrolling some 90,000 square miles of land. The greatest problem, however, is the immense popularity of desert plants.

In the last ten years, plant collecting has become a craze, and cacti are among the most sought-after plant species everywhere—not just in the U.S., but in Europe, the Soviet Union (where collector clubs have grown from 3 to 114 in only 12 years' time), and Japan. Japanese firms routinely run ads in U.S. plant catalogs requesting shipments of rare field-collected cacti. Obviously the ads are working: Arizona's unique giant saguaro cacti are selling for about $40 a foot in Tokyo. Japanese plant dealers recently stripped an island off the coast of Baja, California, of *all* its native succulents (the fleshy plants that include cacti). Several of the plants were endemic to the island.

Many plant nurseries in Europe, especially in Belgium, Holland, and West Germany, depend on imported wild-collected cacti and other desert plants. Last spring German customs officials at Frankfurt airport seized 3,600 of the world's rarest cacti, worth more than $21,000. The plants had been carried in in suitcases by collectors returning from a "cactus study tour" arranged by a Stuttgart travel firm. The year before, *one entire population*—only one other is known—of a very rare cactus entered Germany in 15 suitcases purchased specifically for that purpose by a similar tour group.

But certainly not all field-collected cacti are going out of the country. Many decorate the drought-stricken gardens of southwestern homes and businesses; many more go to large cities, especially in the East. A contact reported seeing an Arizona barrel cactus on a New York street corner selling for $350. Smaller cacti, often collected, are sometimes seen in large chain supermarkets, frequently sporting eyes, noses, even hats—apparel that is usually stuck on with pins, eventually killing those plants that aren't already dead from being uprooted. The "Best of Show" award at the First Eastern Cactus and Succulent Conference, held in fall 1978, went to a highly rare *wild* cactus known to exist in only one place in northern Mexico.

The statistics on the amount of U.S. desert plants actually being harvested are sketchy, though alarming. According to Richard Countryman, under Arizona's native plant law about 2,000 permits are issued each year to legally collect around 80,000 plants. He estimates that another third—almost 27,000 more plants—are being stolen. (However, estimates from the U.S. Fish and Wildlife Service of illegal cactus gathering in Arizona are much higher.) "The waste is terrific too," he said. The cactus cops recently confiscated 30

melon crates of rare and highly collected Arizona rainbow hedgehog cacti. "They were already rotting," added Countryman. "Cactus rustling" in Arizona has become a thriving, million-dollar-a-year illegal business.

Other southwestern states that do not have plant-protection laws or whose laws are not enforced are faring far worse. Some examples: in 1975 a California nursery is reported to have received 16,000 threatened compass barrel cacti, all field-collected in the state; California's Coachella Valley, which used to be a veritable cactus garden, has been totally denuded; an entire colony of a rare cactus in Baja was wiped out by one nursery owner; also in Baja, the fascinating endemic boojums (a member of the unique ocotillo family), most of which count their ages by centuries, are being cut down and used to make cheap candles in Tijuana; whole hillsides of barrel cacti in the Mojave Desert are gone.

But it's Texas that is "really going down the tubes," said Kent Newland, President and Conservation Chairman of the Central Arizona Cactus and Succulent Society. Comprised largely of private ranchlands, Texas is being stripped of its cacti. "Ranchers think they're a nuisance to cattle," Newland explained, "which isn't true since cacti usually grow on rocky, hilly areas that cattle don't care about." Both Newland and two other contacts described some ranchland near Big Bend National Park that is being systematically cleared by commercial dealers of anywhere between 25,000 and 50,000 cacti *each month*—at least one-half million each year. A shed at the site contained up to 30,000 cacti, along with several one-and-a-half-ton trucks piled high with dried-out plants that dealers had apparently forgotten to pick up. Even cacti in Big Bend aren't safe. Gary Lyons, Chairman of the Cactus and Succulent Society of America's Conservation Committee, said that in the park, far from the highway, "huge piles of threatened button cactus were found—all dead." Also, "cacti within one mile of park roads are very scarce," reported Kent Newland. All told, it has been reported that 10 million cacti were shipped out of Texas in 1977.

The result of this massive cactus harvesting is that 72 species and varieties of cacti (26 percent of the family, *Cactaceae*) are recommended by the Smithsonian Institution for protection as endangered or threatened species. Of these 72 species, 75 percent are either privately or commercially exploited. "And information concerning these cacti was obtained in part from commercial catalogs," said Roger McManus, botanist for the Endangered Species Scientific Authority. Lyman Benson, foremost authority on cacti and other plants of the southwest, recounted that right after he had described (cautiously) several new species of small cacti in scientific journals, the plants appeared for sale in various catalogs around the world. According to Benson, "The cactus family may be the most endangered of all major groups of plants."

What can be done to at least impede wide-scale poaching and plundering of American cacti? The U.S. Fish and Wildlife Service, which is responsible for reviewing all plants recommended by the Smithsonian Institution for official listing as endangered or threatened species—and consequent protection under the Endangered Species Act—is currently considering for listing about 20 cacti native to the states of Arizona, Texas, New Mexico, Colorado, and Utah. (California and Nevada are conspicuously missing.) In view of Fish and Wildlife's track record (only four plants were listed in the past ten and a half months), it is doubtful that any but a few of the 20 cacti will have been officially listed by the time this *News* issue is off the press. (The deadline date for listing was November 10, 1979.)

In a testimony given to Fish and Wildlife hearings on Arizona's endangered cacti (held July 11, 1979), Kent Newland said, "A fundamental weakness of the Endangered Species Act is that it provides no emergency listing powers for commercially exploited endangered plant species that do not have time to endure four or five years of the official listing process." Newland believes that rare commercially collected cacti have little chance of survival.

But what of the plants that *are* listed for protection under the Act? Section 9 of the Endangered Species Act prohibits the "taking" of animals, but not of plants. On the other hand, Section 7 *does* prohibit removing plants from public lands (that is, property owned and administered by federal agencies); but it does *not* forbid collecting plants on privately owned land. Again, the Act prohibits interstate commerce in plants, but since few plants currently listed are threatened by commercial collecting, enforcement of this provision, to date, has been complicated and undeveloped.

Concerning the problem of cacti exported out of the U.S.: the Animal and Plant Health Inspection Service (APHIS) of the Department of Agriculture is responsible for inspecting plants as they enter or leave the U.S., asking to see permits, and confiscating illegal specimens. APHIS's duties are outlined by the Convention on International Trade in Endangered Species, called CITES or the Trade Convention. (Ratified by 56 countries, CITES provides a complex mechanism for regulating trade

(continued on page 26)

Oak Leaf Awards 1978

Once a year The Nature Conservancy acknowledges the outstanding efforts of its members through the presentation of the Oak Leaf Award. This award, symbolized by a green and gold lapel pin, is given in recognition of especially dedicated service and support toward achieving the Conservancy's objectives.

Myrle Burk has been an active member of The Nature Conservancy since 1954. In 1971, Dr. Burk stepped down as chairman of the Iowa Chapter after serving two years during the Chapter's critical formative years. Her optimism and persistence kept younger members enthusiastically involved and lead to the chapter's renaissance and recent growth.

Richard Bennink was spreading the word of the Conservancy's work and programs in New England long before the Eastern Regional Office moved to Boston. In 1959, he initiated a successful campaign to protect 400 acres of land in New Hampshire, now the Louis Cabot Preserve. As Executive Director of the Fund for the Preservation of Wildlife and Natural Areas, Mr. Bennink has been instrumental in supporting Conservancy programs including the Massachusetts Natural Heritage Program.

John "Jack" Dayton has served as a trustee or officer, and member of the Executive Committee of the Long Island Chapter for the past 10 years. Shortly after his retirement as an investment broker, Mr. Dayton began a second career of service to the Conservancy. He edited the Chapter's first preserve directory; cleared trails and made presentations to Garden Clubs; set up art shows and sought donations —all with irrepressible enthusiasm. He has played a leading role in the preliminary negotiations and the ultimate acquisition of many of the properties presently owned and managed by the Conservancy on Long Island.

David Harrison has pioneered in using new conservation techniques in Colorado by planning the purchase of water rights to assure the protection of minimum stream flow. Chairman of the Colorado Chapter for the past two years and Chapter Trustee for six years, Mr. Harrison's legal skill has proved indispensable. Most recently, Mr. Harrison has been instrumental in the successful negotiations leading to the creation of the Colorado State Heritage Program to inventory the state's natural areas and make recommendations for future land use decisions.

Helmut Kohnke introduced members of Indiana's academic community to the program of The Nature Conservancy. After spearheading the drive to acquire Fall Creek Gorge and organizing volunteers to manage the area, Dr. Kohnke led the successful opposition to the Army Corps of Engineers Big Pine Creek Dam Project which would have flooded the preserve. Having served ably as Chairman and trustee of the Indiana Chapter, as Chapter Vice-President for Land Acquisition, Dr. Kohnke insured the acquisition of such important areas as Shrader-Weaver Woods, a National Natural Landmark.

Joel and Bertha Massie have functioned as an effective team for the Conservancy since they became charter members of the Missouri Chapter in 1956. Mrs. Massie has worked diligently for years as membership secretary of the Chapter and has edited, produced, and mailed the Chapter's newsletter. An avid birdwatcher, Mrs. Massie has sighted well over 3,000 species. Mr. Massie, former member of the national Board of Governors, serves as the Chapter's treasurer. Both Massies have given freely of their time and resources, notably to Pleasant Valley Cave in Jefferson County, Missouri.

Hustace Poor has a long history of able service to The Nature Conservancy. One of the Conservancy's first members, Mr. Poor supported the Conservancy's first project, Mianus River Gorge. He went on to become a founder and the treasurer of the Virginia Chapter. For the past six years, Mr. Poor has been treasurer of the Ohio Chapter, which he has also served as vice-chairman.

Virgil Rule has been a driving force behind Conservancy activity in Arizona and is currently Arizona Chapter Chairman. Membership in the Arizona Chapter has doubled in the last year. Under his leadership, the Chapter has encouraged the Arizona Parks Department and the Arizona Fish and Game Department in their management of critical natural areas. Mr. Rule and colleagues in the Arizona Chapter have been able to effect the creation of an Arizona Heritage Program with Governor Bruce Babbitt as the Chairman of the fund raising committee.

Mary Shannon is one of the early leaders and mainstays of the Texas Chapter. Devoting much of her time as Chapter secretary and editor of Texas Horizons, the chapter's newsletter, she has provided the adhesive of information to keep the geographically widespread membership together. Dr. Shannon's doctorate in Zoology has proved invaluable in the ecological evaluation of Conservancy holdings and potential projects.

Waid Vanderpoel, as Vice-President for Retirement and Endowment Funds for the First National Bank of Chicago, introduced the land saving work of the Conservancy to top level corporate executives. He influenced his own bank to support the operations of the Illinois Chapter—the bank's first venture into environmental philanthropy—and, more recently, to lend its support toward the purchase of Braidwood Dunes and Savannah.

President's Stewardship Awards

Each year the Conservancy recognizes a committee and an individual who have contributed significantly to the advancement of the art of Stewardship on Conservancy preserves.

Ethan Becker, Co-chairman of the Ohio Stewardship Committee, provided the leadership, initiative and financial support necessary to execute a highly successful inventory and master plan program. Through his energies he has made possible the completion of master plans for 10 Conservancy-owned preserves in Ohio. In addition to supervising two student interns in this master planning process, he provided them with office and living space, secretarial support, equipment, and constant moral support. His enthusiasm and insights have helped all involved to realize and appreciate the importance and feasibility of planned preserve management.

The Matanzas Pass Stewardship Committee put together a strong preserve program which benefits the educational systems and the local community organizations in the Fort Myers area. Local high school students designed and developed a catwalk through the preserve and a sheltered pavilion over the water. They also completed and implemented a Master Plan. The Committee provided the community with a preserve to enjoy and also enabled the public to understand the value of a mangrove ecosystem.

Annual Chapter Award

The Florida Chapter was selected by the Board of Governors to receive the Outstanding Chapter Award for its accomplishments during 1978. The award was presented to Florida volunteers and staff for the best chapter performance in all areas including: membership, development, public relations, stewardship of preserves, planning, and acquisition of ecologically significant natural areas.

President's Special Award

Chris T. Delaporte, Director, Heritage Conservation and Recreation Service, U.S. Department of Interior, and past Director of State Parks in Oklahoma, has been responsible for protecting key elements of America's diverse natural heritage. The President's special award was given in acknowledgment of Mr. Delaporte's personal concern and commitment to the protection of natural areas and the rich variety of life they safeguard.

Distinguished Service Award

Richard Durrell and **Lucile Durrell** were honored with a special distinguished service award. The award was presented in grateful recognition of their outstanding work for The Nature Conservancy throughout the past almost three decades. Their leadership brought The Nature Conservancy to Ohio and subsequently resulted in the founding of the Ohio Chapter. They have each been involved in a wide range of conservation activities within the state and within the Cincinnati region. They provided the inspiration and gave support to the establishment of the Edge of Appalachia System of Preserves. The system, created over a 20-year period, protects the unique meeting place of the eastern forests and western grasslands.

ECOLOGY FORUM (continued from page 24)

in endangered and threatened plants and animals, including their by-products.) Until recently APHIS has totally ignored its duties to enforce CITES directives. According to Faith Campbell, a specialist in wildlife and plant conservation with the Natural Resources Defense Council, APHIS's "policy" has resulted in "virtually unregulated trade in rare and protected plants."

It is clear that the laws or techniques designed to protect endangered and threatened species either omit plants, are too weak, or are not enforced whatsoever. In *Extinction is Forever,* Lyman Benson wrote, "the most promising methods of protection of the cacti . . . are by *legislation* and habitat preservation. But to be effective, laws must have public support. If they lack such support, they are either forgotten or flouted, as were the Eighteenth Amendment and the accompanying Volstead Act."

"But," said Bruce MacBryde, botanist with the Endangered Species Office, "how can we successfully enforce rules against collecting plants in a country where people still shoot bald eagles?"

Alaska

CHILKAT EAGLES (Haines Borough). Salmon running the Chilkat River across this southeastern Alaskan wet forestland are a ready food supply for the world's densest wintering concentration of bald eagles. 320 acres of this critical habitat are a gift of Dorothy Whitney and Lois Jund. The historic Dalton Train and Dalton homestead are located on the property. The area will be conveyed by restricted gift deed to the National Audubon Society for management.

California

MORLAND PRESERVE—Addition—(Riverside County). Meadow land, not found on the existing 300-acre preserve, makes up part of this 80-acre gift of Life Dynamics Fellowship. Sycamores, toyon, live oak and squaw bush are the dominant vegetation. Fox and bobcat roam the preserve and great horned owl and white-tailed kite hunt the grassland. Management of the area will be the responsibility of a local stewardship committee.

WILDER BEACH (Santa Cruz County). One of only two remaining nesting sites in Santa Cruz County for the snowy plover, the 60-acre area is located at the mouth of Wilder Creek just north of Santa Cruz, California. Composed of coastal marsh, lagoon, and dune, the property supports a variety of rushes and sedges as well as yellow verbena, sea rocket, and beach morning glory. After it is transferred to the California Department of State Parks, the property will be managed as part of the existing Wilder Ranch State Park.

Colorado

MUELLER RANCH—Addition—(Teller County). In the heart of the bighorn sheep range, the 640-acre property contains Dome Rock, an 800-foot-high granite landmark. The tract will be donated to the State of Colorado as an expansion of an already protected wildlife area.

Connecticut

WEIR PRESERVE—Addition—(Town of Wilton). This 7-acre property borders a small meandering marshy stream and is part of the planned assemblage for the almost 90-acre preserve. Given to the Conservancy by Helen Irwin Littauer, the property will be managed by the Connecticut Chapter.

Florida

ROBERT BATTEY PRESERVE (Lee County). A gift of Mrs. Francis Curtis in memory of her father, this 120-acre mangrove forest is a roosting and resting area for eastern brown pelican, osprey, great blue heron, white ibis, bald eagle,

NEW PROJECTS

and the mangrove cuckoo. The area will be managed by the Sanibel-Captiva Foundation until it is transferred to the U.S. Fish and Wildlife Service to become part of the Matlacha Pass National Wildlife Refuge.

Illinois

CAMP ROTARY MacQUEEN (DeKalb County). High on a bluff overlooking the Kishwaukee River, this 46-acre site was once used for weekend scouting activities. Consisting of flood-plain forest and bottomland, the area's varied soils support a wide variety of wildflowers. The property will be transferred to the DeKalb County Forest Preserve District for management.

Indiana

MORAINE PRESERVE—Henry George Hollinshead Addition—(Porter County). A high diversity of ferns and wildflowers, including golden seal and ladies tresses orchids, is found on this 20-acre gift of Rosemary R. Aldrich. Predominantly forested with mature second-growth stands of red oak, sugar maple, and beech trees, the tract will help buffer the existing nature preserve. The entire area, now totaling almost 300 acres, has been transferred to and is managed by the Indiana Department of Natural Resources as a dedicated natural area.

Maryland

OTWELL WOODLAND (Talbot County). The 100 acres of loblolly pine and old-growth oak-hickory forest are a gift of Mrs. John Jackson. Bordered on one side by Trippe Creek, a tributary of the Tred Avon River, the property is potential habitat for the endangered Delmarva fox squirrel. Management of the area will be the responsibility of the Maryland Chapter.

Minnesota

CHIPPEWA PRAIRIE — Addition — (Chippewa County). The addition of 40 acres of tall to mid-grass prairie brings the total protected area to 809 acres. The greater prairie chicken has been reintroduced here and studies are being conducted to determine if a breeding population has established itself. The property, to be managed by the Minnesota Chapter, is a unit of the Ordway Prairie System.

MORGAN WOODS (Washington County). Openings in this rugged rolling deciduous woodland support characteristic prairie plants including lead plant and little and big bluestem grasses. The addition of 20 acres brings the total protected area of the preserve to 60 acres. A gift of Samuel H. and Natalie P. Morgan, the area has been transferred to the Science Museum of Minnesota for administration by the Lee and Rose Warner Nature Center.

TROUT LILY PRESERVE (Rice County). This 27-acre preserve contains the largest known concentration of Minnesota's only endemic plant species, the dwarf trout lily (*Erythronium propullans*). Trout lily occurrences are measured by the number of colonies present, and this preserve harbors 110 colonies, compared with 69, 52, and 25 colonies on the next largest sites. The preserve encompasses a steep ravine and creek bottom to protect the north-facing floodplain flats where the rare plant occurs. The Minnesota Chapter, which will manage the area, is fundraising for the project.

Missouri

VICTORIA GLADE — Additions — (Jefferson County). Twelve native grasses and 75 wildflower species or forbs have been identified on Victoria Glade. The best known and only protected example of eastern Missouri glade is further protected with two additions totaling 2 acres. The area is to be transferred to the Missouri Department of Natural Resources for management.

New Mexico

SAN ANDRES NATIONAL WILDLIFE REFUGE (Dona Ana County). A two-acre lot was acquired as a headquarters site for the Refuge which is excellent habitat for bighorn sheep. Just off a main highway, the property is an ideal location to disseminate information to refuge visitors. The property will be transferred to the U.S. Fish and Wildlife Service.

New York

MIANUS RIVER GORGE—Addition—(Westchester County). The 1.6-acre tract of gently rolling land is crossed by a stream which connects to a pond and the Mianus River. The tract is a gift of Robert E. and Dorothy C. Burbank to the Conservancy's oldest preserve. The area is managed by the Mianus River Gorge Committee.

WERTHEIM REFUGE — Addition — (Suffolk County). Little Neck Creek, a tributary of the Carmans River which is identified as "scenic" under the New York State Wild, Scenic, and Recreational Rivers Act, crosses the 32-acre tract. The area is valuable habitat for some 20 varieties of warblers. The entire assembly will be transferred to the U.S. Fish and Wildlife Service for management.

North Carolina

MERCHANT'S MILL POND — Additions — (Gates County). Breeding area for large numbers

McFaddin Ranch

On the Texas Gulf Coast, just 20 miles southwest of one of the nation's largest petro-chemical complexes at Port Arthur-Beaumont, these 41,682 acres of coastal prairie and brackish marshlands were a logical site for a new tank farm. But, the area had also been targeted as one of the top five of 25 areas the U.S. Fish and Wildlife Service wanted to acquire for a refuge, and after two and one-half years of negotiations, the Conservancy has secured title to the property.

In addition to being a key feeding and wintering site for waterfowl on the continent's Central Flyway, the fertile, productive marshland also harbors some 13 threatened or endangered animal species. Brown pelicans and American alligators are year-round inhabitants of the area where southern bald eagles and peregrine falcons feed during the winter months. Red wolves roam the higher elevations of the tract while shrimp and crabs, vital catch for the Gulf's fishing industry, spawn in the marshy depths.

Adjacent to 9,000-acre Sea Rim Ranch State Park, which the Conservancy helped acquire in 1978, McFaddin Ranch will be transferred to the U.S. Fish and Wildlife Service for management.

of swamp warblers, these 212 acres include a 75-acre gift from A. B. Coleman. Black vulture, least bittern, yellow-crowned night heron, red-shouldered hawk and the federally endangered red-cockaded woodpecker have all been observed in this critical narrow wildlife corridor connecting Chowan Swamp, Merchant's Mill Pond State Park and Dismal Swamp. Four species of rare aquatic plants grow along the property's one mile of shoreline on Merchant's Mill Pond, and mature cypress-tupelo swamp is found along a three-quarter mile frontage on Bennett's Creek. Management of the area will be the responsibility of the State of North Carolina.

Oregon

LOWER TABLE ROCK/KELLY SLOUGH—Addition—(Jackson County). An addition of 30 acres and the mineral rights for an adjacent 177 acres further protect the beautiful bayou-like channels and sloughs. The area, which provides habitat for northern bald eagles and protects a great blue heron rookery, will be transferred to the Jackson County Parks Department for inclusion in the Bear Creek Greenway Project. A $500,000 fund-raising campaign is underway by the Northwest Field Office to purchase the adjacent Lower Table Rock.

METOLIOUS RIVER PRESERVE (Jefferson County). Surrounded on three sides by U.S. Forest Service land, the 7.5-acre undisturbed woodland fronts a clear, cold spring-fed river surrounding a pristine island. Western tanager, goshawk, MacGullivray's warbler, harlequin duck, and river otter have all been sighted here. The property, a gift of Erskine B. Wood in honor of his father, Erskine Wood, will be managed by a local Conservancy stewardship committee.

Tennessee

JESS JENKINS CRANBERRY BOG (Johnson County). This one-quarter-acre area contains what is possibly the last remnant of extensive bog vegetation that formerly occupied the bottoms of Shady Valley. Plant species of special concern on the tract are aster and aiton, a threatened species in Tennessee. The area will be conveyed to East Tennessee State University for management.

Texas

ROY E. LARSEN SANDYLAND SANCTUARY—Addition—(Hardin County). A gift of the Gulf State Utilities Company, the 40-acre right-of-way cuts across all four communities of the sanctuary—forest, swampland, southern pineland, and sandyland. The area harbors several rare plants, including the carnivorous purple bladderwort, water willow, and two rare sedges. One of the most

sensitive areas of the preserve, the addition will be managed by the Conservancy's Sandyland Preserve Steward.

Vermont

FRANKLIN BOG—Addition—(Franklin County). The 40-acre gift of Harland G. and Ruth E. Titemore brings Conservancy ownership of the National Natural Landmark to 122 acres. An assembly of 150 acres is planned in the area which protects numerous bog flora such as pitcher plants, Arethusa orchids, sheep laurel, and Labrador-tea. Management of the area will be the responsibility of the Vermont Chapter.

HOWE POND (Bennington County) and WEST RIVER (Windham County). The Conservancy purchased approximately 630 acres on the West River Greenway and transferred the land for management to the state as an addition to Jamaica State Park. In return, the state transferred to the Conservancy some 594 acres of Howe Pond State Park, which was then donated by the Conservancy to the Village of Readsboro to be used as a municipal forest and public water supply. The entire transaction was made possible by a gift of 4,000 acres by Henry F. Harris. Part of the proceeds from the sale of the Harris tract to the U.S. Forest Service financed the purchase of the West River tract. The Howe Pond property is wooded and contains a large pond which will be used as a reservoir. Portions of the wooded addition to Jamaica State Forest border the West River and contain beaver ponds and other wetlands.

Wisconsin

GENESEE OAK OPENING (Waukesha County). The 51-acre tract contains the best known example of a burr oak savannah plant community in Wisconsin. Pickerel frogs and Blanding's turtles, both threatened in Wisconsin, thrive in a stream and marshland along the southern and eastern edges of the property. The area will be managed by the Wisconsin Chapter until it is transferred to the Wisconsin Department of Natural Resources.

Correction

The Cedar Glen article in the last issue of the *News* omitted saying that the Illinois Department of Conservation originated the 1976 "Dimes for Eagles" drive. Also, John Warnock is the land steward for Cedar Glen, and Emory Carson is the on-site resident manager.

Roy E. Larsen

Roy E. Larsen, member of the Conservancy's Board of Governors since 1974 and a life-long conservation advocate, died at his Fairfield, Connecticut, home in September at the age of 80.

Mr. Larsen, who recently retired after 56 years as a key executive at Time, Inc., was instrumental in safeguarding wildlands in his native New England and elsewhere in the nation. He helped form the Nantucket (Massachusetts) Conservation Foundation, which has protected a significant portion of that island's fragile environment, and donated land to that organization and to the Connecticut Audubon Society. The wetlands, woods, and meadows of the Roy and Margot Larsen Sanctuary in Fairfield provide habitat for deer, foxes, and a variety of native birds.

A 2,138-acre gift of land in the Big Thicket area of east Texas—made to the Conservancy by Time, Inc., through its forest products subsidiary, Temple-Eastex, Inc.—was designated in 1977 the Roy E. Larsen Sandylands Sanctuary in his honor.

Among his manifold accomplishments outside of conservation, Mr. Larsen served as the first publisher of *Life* magazine; organized the National Citizen's Commission for the Public Schools; and played a major role in creating the "March of Time" film series, which won an Academy Award in 1937 for "revolutionizing" the newsreel.

COTTAGES AVAILABLE AT MILE HI

Modern housekeeping cottages overlooking a mountain creek are available for rental year-round at the Conservancy's Mile Hi Ranch. Located 90 miles southeast of Tucson in the Huachuca Mountains, the Mile Hi stretches across the mouth of Ramsey Canyon, one of the most lovely and biologically diverse canyons in southern Arizona.

To arrange a visit or obtain a brochure and birdlist, write: The Mile Hi, RR 1, Box 84E, Hereford, Arizona 85615. Phone: (602) 378-2785.

Photos: Lynn Almer, p. 4 top left, p. 4-5; Jim Anderson, pp. 15, 16 left and top right; Susanne Anderson, p. 27; Kristin Berry, p. 20 left; Robert D. Berry, p. 18; Susan Bournique, inside front cover, p. 17; Robert I. Gilbreath, p. 9 top right; Melvin Horton, p. 4 lower left; Tim Loomis, p. 9 top left, 16 lower right; Susan Rust, p. 29; Gail Schroeder, p. 13, 16 left; David Soltz, p. 9 bottom, 10; Beverly Stevenson, pp. 20-21; Bruce Wolfe, p. 5.

NEW LIFE MEMBERS

An individual becomes a Life Member of The Nature Conservancy upon contribution of $1,000 for membership dues.

Ms. Judith L. Ainsworth
Washington

Ms. Kate Appleby
Vermont

Mrs. Rowena D. Becker
Virginia

Mrs. Eve Clayton
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Mr. Shawn Concannon
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Mrs. Dorothy Lillian Copeland
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California

Mrs. Bissell Wood
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NEW CORPORATE ASSOCIATES

A corporation becomes a Corporate Associate of The Nature Conservancy upon contributing between $1,000 and $10,000 annually to the operations of the organization.

Bowater Incorporated
Connecticut

Central Telephone & Utilities Corporation
Illinois

Crown Zellerbach
California

Jack Daniel Distillery
Tennessee

Donnelly Mirrors, Inc.
Michigan

INA Foundation
Pennsylvania

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Pennsylvania

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Tennessee

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Pennsylvania

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Contributions are tax-deductible. Please make checks payable to The Nature Conservancy. Please clip this coupon and use the envelope bound in this issue or mail to: The Nature Conservancy, 1800 N. Kent Street, Arlington, Virginia 22209.

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